Contamination

The Eastern Snake River Plain Aquifer covers more than 10,000 square miles, extending from Ashton to King Hill. The water in the aquifer flows to the southwest at about 10 feet per day until it enters the Snake River in the Thousand Springs area near Twin Falls.

The aquifer is a source of drinking water for thousands of rural residents and numerous communities, and plays a critical role in the agricultural industry of southern Idaho. Scientists have estimated that the aquifer may contain as much water as Lake Erie.

Activities at the INEEL during the past 50 years have affected the aquifer in some areas, primarily near major facilities. However, the increased environmental awareness of the 1970s and 1980s brought about a recognition of the importance of the aquifer. As a result, INEEL changed waste disposal practices so that groundwater was affected less or not at all. These changes include elimination of injection wells, monitoring of liquid effluent discharges, and improved wastewater treatment systems.

Much of the work currently being done at the INEEL relates to correcting errors made in the past. An agreement called the "Federal Facilities Agreement and Consent Order" (usually referred to as the FFA/CO) was made to implement the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund) at INEEL.

The Department of Environmental Quality, DOE, and EPA jointly oversee activities under the agreement.

Some cleanup programs have had limited success, but most have produced tangible results. For example, at the Radioactive Waste Management Complex, a treatment system was installed to extract vapors from organic solvents in the rock and soil above the aquifer to prevent further contamination. At Test Area North, a groundwater treatment system is operating to improve water quality near that facility.

Contaminated soil at many areas of the site has been covered or taken to engineered disposal sites. These environmental cleanup programs, coupled with the decrease in the discharge of contaminants to the aquifer, spell good news for southeast Idaho.

INEEL operations have contaminated the groundwater in the Eastern Snake River Plain Aquifer with everything from chemical solvents to radioactive isotopes. Moreover, these pollutants didn't end up in the aquifer accidentally—in most cases, the pollutants were injected into the aquifer intentionally and legally. Laws regulating the disposal of wastewater weren't passed until the mid-1980s—over 30 years later.

Of the many disposal methods employed at the INEEL over the past 50 years, wells and percolation ponds are the principal sources of contaminants in the aquifer. Understanding the circumstances of the times can help us better understand why these methods were used.

In 1949, the Atomic Energy Commission (the predecessor to the U.S. Department of Energy) picked a location at which to build, test, and perfect nuclear reactors. Two criteria for this site were an isolated location and an ample water supply. The southeast Idaho desert, with its underlying aquifer, fit the bill. By 1951, the National Reactor Testing Station (the INEEL's original name) had produced useful electricity. The reactor that produced these initial kilowatts of power was just one of 52 reactors eventually built on the INEEL, along with associated research centers and waste-handling and storage areas.

With reactors came radioactive and hazardous wastewater. Scientists knew they needed to dispose of wastewater in a manner and place to keep them away from humans. Injection wells and percolation ponds seemed to be the solution: the waste was injected (or allowed to seep) into the ground, thus minimizing any chance of human contact. The size and location of the aquifer would dilute the pollutants and isolate the waste for years to come. In 1953, when the first injection well was built, wells seemed to be the best solution.

Injection Wells

Injection wells were drilled into the aquifer to inject wastewater directly into the groundwater, where pollutants would be diluted by the large amount of water in the aquifer. Wastewater injections ended in 1986.

The first injection well was constructed in 1953 at the Idaho Nuclear Technology and Engineering Center (INTEC, then called the Idaho Chemical Processing Plant). It was used to dispose of low-level radioactive, chemical, and sanitary wastewater. Between 1953 and 1984, an average of 360 million gallons of contaminated water were pumped down the 600-foot-deep injection well into the groundwater below INTEC each year. The well was used again in 1986, then sealed in 1989. It is the primary source of groundwater contamination at INTEC.

Another injection well is the primary source of groundwater contamination at Test Area North. A 305-foot deep well was used to dispose of low-level radioactive, chemical, and sewage wastewaters from 1953 – 1972. The well left behind chemicals and radioactive contaminants, including trichloroethene, dichloroethene, tetrachloroethene, Cesium-137, Strontium-90, tritium, and uranium.

In addition, a 1,270-foot deep injection well was used at the Test Reactor Area (TRA) from 1964–1982. This well was used primarily for non-radioactive water used to cool reactors, and it is not a major contributor to groundwater contamination.


Injection wall housing (left) and wellhead (right) at Test Area North. This well was once part of a problem, when it was used to dispose of contaminated wastewater and sewage. It is now part of a possible solution, used in a bioremediation project to inject sodium lactate into the same area.

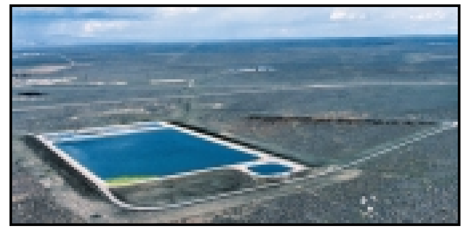
Percolation Ponds

Today, most liquid sewage, chemical, and radioactive wastes are discharged to ponds, where it slowly seeps through soil until it reaches the aquifer. The soil and rocks beneath the ponds act to filter some of the pollutants from the water as it passes through. But not all of the pollutants adhere to the soil and rocks, some end up in the aquifer.

The Department of Energy used percolation ponds to dispose of radioactive and chemical wastes at TRA from 1952 - 1990s. These ponds are known contributors to groundwater contamination beneath the INEEL. In the 1990s, the percolation ponds at TRA were capped and replaced with lined evaporation ponds. With this change, water quality near TRA has improved over time.

When the INTEC injection well ceased operation in 1986, two unlined wastewater percolation ponds were built to dispose of the wastewater and remain in use today. Because water from the percolation ponds appeared to spread contamination from the INTEC tank farm, DOE has agreed to relocate the ponds. In 2001, DOE will close down the old ponds.

Many facilities at INEEL used percolation ponds or injection wells to dispose of wastewaster. Water in the unlined ponds slowly seeped into the ground, and eventually made its way to the aquifer below.



A plume is a contaminated area of the aquifer that can be traced to a single source. Many plumes move through groundwater as it moves, but others remain in the same place or even appear to "shrink" as contaminants decay or dissipate.

Tracking contamination

The INEEL Oversight Program, the U.S. Geological Survey, the U.S. Department of Energy, and other agencies and organizations continuously monitor groundwater, surface water, and drinking water on and near the INEEL and in the Magic Valley area. This monitoring allows scientists to track the plumes of contamination from the INEEL.

Most of the liquid radioactive effluent injected into the aquifer at the INEEL was tritium. Tritium disposal at the INEEL began in 1953 and continued steadily until the 1980s and 1990s, when it dropped off sharply.

Because of the effect of half-life (tritium has a 12.3 year half-life, meaning half of the tritium present decays every 12.3 years), the concentration of tritium has been decreasing ever since.

Testing of ground water for tritium began in 1956, and became routine in 1961. Also in 1961, the U.S. Geological Survey first mapped the contaminant plumes in the groundwater beneath TRA and INTEC. A 1970 map shows that tritium plumes beneath TRA and INTEC were continuing to spread. In 1977, the U.S. Geological Survey found that the TRA and INTEC plumes had merged into one. This plume, the largest under the INEEL, is now effectively shrinking instead of expanding. While the pollutants are still being carried further and further from their source at TRA and INTEC, they are decaying and becoming diluted to a point that they are no longer detectable, which makes the plume of contamination appear to shrink.

No contaminants from the INEEL have been found in or near the Magic Valley, and it is highly unlikely they ever will. Cleanup programs on the INEEL, better disposal methods, and less contaminated wastewater to begin with, coupled with natural dilution, chemical breakdown, and radioactive decay of the contaminants, should cause the detectable plumes to continue to shrink under the INEEL.

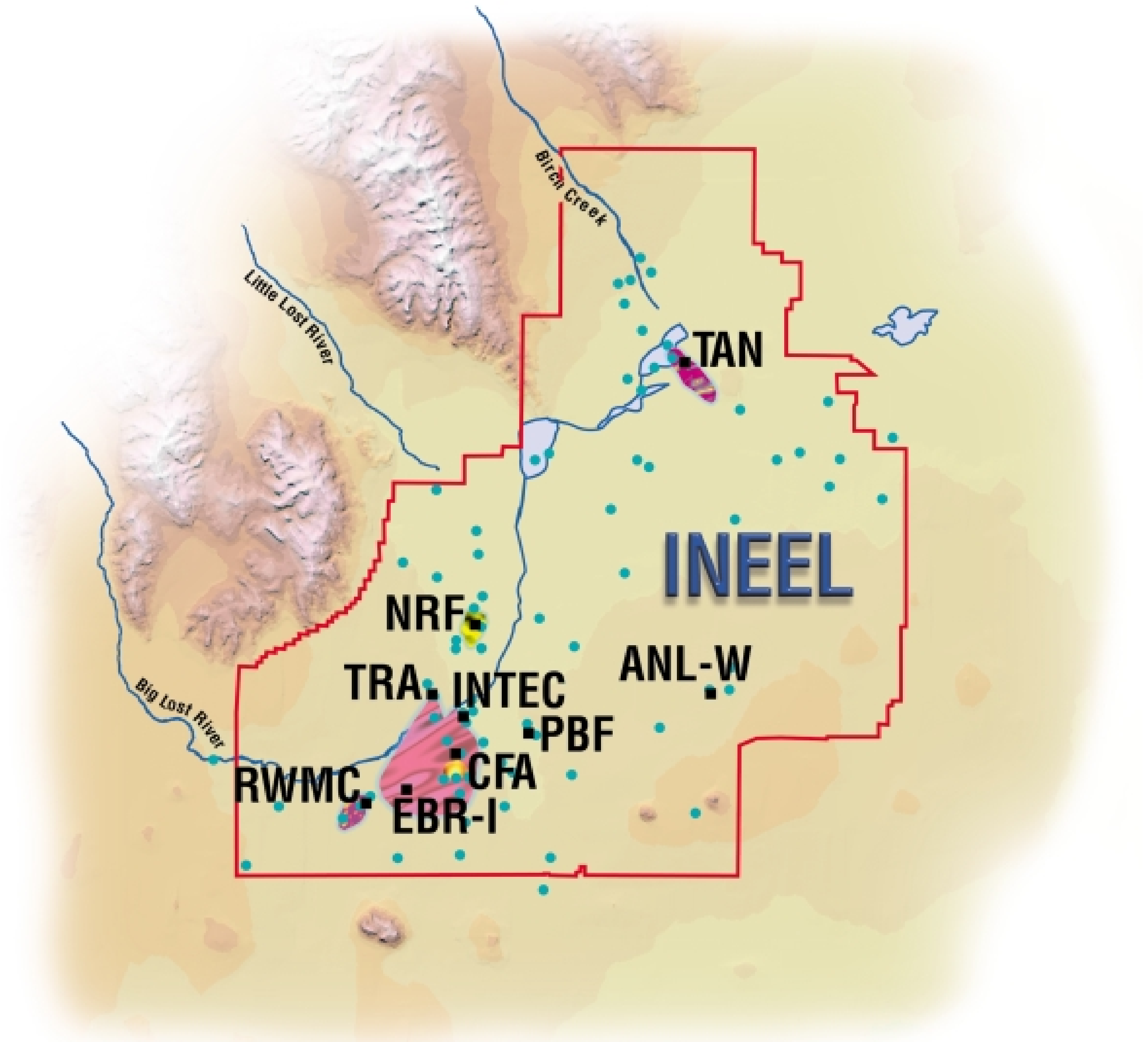
Although the injection wells have been closed down, and in many places lined ponds have replaced percolation ponds, the contaminant legacy will remain in the Eastern Snake River Plain Aquifer for many years. However, the healing process in the aquifer has begun, and technologies now being studied may help bring the aquifer back into good condition.

Test Reactor Area seen across percolation pond, 1967. These ponds were legal, and were used in many places, by both government agencies and private businesses. Some are still in use today.

Groundwater monitoring wells help scientists track the progress of a plume, and determine what is happening with the contaminants in the water. Monitoring wells also help us figure out what types of material—rock, sand, clay—are under the ground at a specific location.

Although we would like to have more information, we don't drill wells indiscriminately. They're expensive to drill—at least $100 per foot on the INEEL—and are typically 500 to 700 feet deep.

If not drilled properly, wells can also provide a pathway for contamination to travel from the surface of the earth or between zones of the aquifer.



Contamination of groundwater under the INEEL

The fractured basalt underlying the Eastern Snake River Plain in southeast and south-central Idaho acts as a giant underground sponge. Groundwater fills in the cracks and crevices in the rocks, creating the Eastern Snake River Plain Aquifer. Just as a sponge can hold germs and cleaning chemicals after being used, the aquifer also holds contaminants from the INEEL. Five "plumes" of groundwater contamination reside under the INEEL and are direct results of INEEL activities. The plumes contain both hazardous and radioactive components.

The locations of the plumes and the concentrations of contaminants in them are tracked through extensive research and monitoring. Monitoring shows the concentrations of contaminants in all of the plumes are decreasing and that none of the plumes extend beyond the boundaries of the INEEL. Some of the plumes are being treated to remove contaminants, while others are simply being monitored. Cleanup activities at the INEEL are helping to decrease contaminant concentrations, as are the natural processes of radioactive decay and chemical breakdown.

Test Area North

Test Area North (TAN) was established in the 1950s and has been used for studying nuclear-powered aircraft, reactor design, and spent nuclear fuel.

Installing jet fuel oil tanks at TAN, 1954. The feasibility of a nuclear-powered aircraft was one of many ideas studied at TAN.

Where did it come from?

A 310-foot injection well used to dispose of low-level radioactive, chemical, and sewage wastewaters.

When did it occur?

1953 - 1972

What contaminants are in the water?

Solvents such as trichloroethene, dichloroethene, and tetrachloroethene; radionuclides including Cesium-137, Strontium-90, tritium, and uranium.

Is the plume expanding?

Yes. Groundwater in this area moves at a rate of approximately six inches per day. The fastest-moving pollutants move with the water at approximately the same rate. Trichloroethene is the most mobile of the chemical pollutant and is the primary contaminant at TAN. Tritium also moves rapidly with the water, but due to its short half-life (12.3 years) and relatively low concentrations, it is not considered to be of concern. The remaining pollutants do not move rapidly in the aquifer, and are not anticipated to pose long-term health hazards.

What's being done to clean it up?

Cleanup of the plume began in 1993. Since then, water has been withdrawn from the aquifer and treated to remove contaminants (called a "pump-and-treat" system).

The plume has been divided into 3 zones, for which different treatment options have been proposed. DOE hopes to use enhanced in situ bioremediation, which releases native microbes to break down the chemical solvents, to clean up the most contaminated zone under TAN. A pump-and-treat system is proposed to clean up the medial contamination zone, and monitored natural attenuation (letting the chemicals and radionuclides naturally disperse and decay) is proposed for the least contaminated zone.

Test Reactor Area/Idaho Nuclear Technology and Engineering Center

Plumes resulting from activities at the Test Reactor Area and the Idaho Nuclear Technology and Engineering Center have merged to form one large plume in the south-central portion of the INEEL. The plume not only underlies these two facilities and the ground between them, but also extends under the Central Facilities Area.

Where did it come from?

Radioactive waste percolation ponds at TRA and an injection well and leaks and spills from tanks at INTEC have been the primary causes of this plume.

Between 1953 and 1984, an average of 420 million gallons of contaminated water per year were pumped down a 600-foot deep injection well into the groundwater below INTEC. The well was used once in 1986 and capped in 1989.

Percolation ponds replaced the injection well at INTEC. The ponds were a source of groundwater contamination for many years; however, the water currently discharged to the ponds generally meets drinking water standards due to improved treatment methods.

When did it happen?

TRA's percolation ponds were used from 1952 – 1994. The INTEC injection well was used from 1953 – 1986; the INTEC "tank farm" began operation in 1953 and is still used today. After the injection well at INTEC ceased operation, two wastewater percolation ponds were built in 1984 and 1985 and remain in use today.

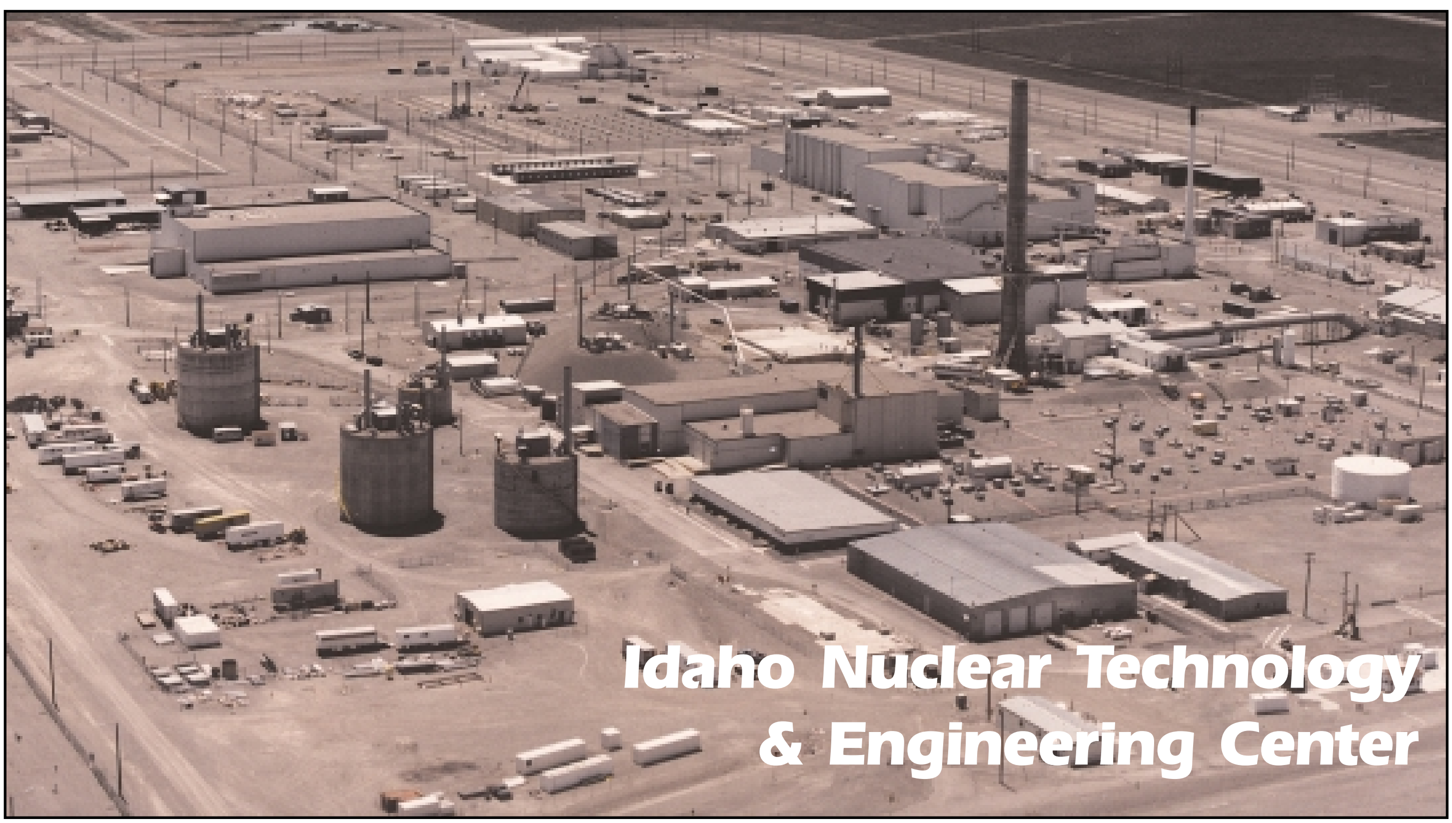
What contaminants are in the water?

The primary contaminants are radionuclides including Strontium-90, tritium, Technicium-99, and Iodine-129. Tritium and Strontium-90, the two primary contaminants, have relative short half lives of 12.3 years and 28.6 years, respectively.

However, some of the radioactive contaminants have extremely long half-lives: Iodine-129 has a 15.7 million year half-life, and Technicium-99 has a 213,000-year half-life.

How big is the plume? Is it expanding?

The TRA/INTEC plume is by far the largest



groundwater contaminant plume under the INEEL. As contaminants are decaying, the plume gives the impression of shrinking. In 1985, the measurable plume covered approximately 51 square miles. The plume has "shrunk" to less than 40 square miles today. However, the plume cannot actually shrink. The concentrations of contaminants at the fringes of the plume become so small due to dilution, radioactive decay, and chemical breakdown that they are no longer detectable, giving the impression that the plume is shrinking.

At what concentrations are the contaminants?

Monitoring shows that Iodine-129, Strontium-90, and tritium are all present in concentrations above the maximum level allowed for drinking water. There has been a continuous decline in concentrations of tritium and Strontium-90 in test wells. Because of its long half-life, scientists are concerned about the future long-term risks posed by the Iodine-129 in the groundwater. However, because of limited sampling for Iodine-129, there is not enough data on the Iodine-129 contamination to show trends.

What's being done to clean it up?

This plume is being monitored, but no cleanup activities are underway. The short half-lives of the two primary constituents, tritium and Strontium-90, have naturally reduced the concentrations of these radionuclides in the groundwater. It is expected that natural attenuation, dispersion, and decay will be sufficient to reduce aquifer contamination to acceptable levels within 100 years for all constituents, except possibly Iodine-129. However, these natural mechanisms will be insufficient if contaminants continue to enter the aquifer at current rates. To reduce the amount of contaminants entering the aquifer, researchers are looking at ways of stranding contaminants from INTEC seepage ponds and tank farm spills and leaks in an unsaturated zone of soil above the groundwater by reducing the amount of water that seeps into the ground at these areas. Future monitoring and studies will dictate if cleanup will be necessary in the future.

Percolation pond at the Test Reactor Area.

Radioactive Waste Management Complex

Radioactive and chemical wastes have been buried in trenches and pits at RWMC since 1952. Waste is buried in pits and trenches, and some is stored above ground. The stored waste will be treated and shipped to WIPP.

Where did it come from?

Unlike the other plumes at the site, neither a percolation pond or an injection well has contributed to the plume of contamination in the ground water under the RWMC. Instead, containers of radioactive and chemical wastes have corroded, releasing carbon tetrachloride vapors into the "vadose" zone–a 580-foot thick unsaturated zone beneath the earth's surface but above the aquifer.

Flood, like the one in 1962 shown below, have also driven contaminants deeper into the ground.

That's why flooding, a concern at all facilities at the INEEL, is a particular problem at the INEEL. Several huge "spreading basins" have been built to divert and hold flood waters away from the RWMC.

When did it happen?

Disposal began in 1952 and will continue through 2006, with an exception for certain wastes generated by the Navy, which can be disposed of until 2008.

What contaminants are in the water?

Chemicals used at Rocky Flats as solvent cleaners, volatile organic chemicals including carbon tetrachloride, 1, 1, 1, trichloroethane, trichloroethene and tetrachloroethene. Rocky Flats, a weapons-production facility in Colorado, sent much of its waste to the INEEL.

At what concentration is the contaminant?

Carbon tetrachloride has been found at concentrations between, just above, and just below the drinking water standard of 5 parts per billion. Tritium has been detected at levels far below the drinking water standard.

Is the plume expanding?

Remediation activities have been underway since 1996. Scientists think the plume has not expanded since then.

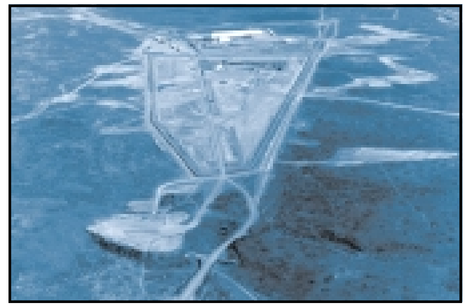
What's being done to clean it up?

The contaminated groundwater beneath RWMC is not being treated. Instead, the cause of the problem is being treated to prevent further contamination. Vacuum pumps in wells are being used to extract the vapors from the vadose zone. A thermal oxidation unit then destroys the carbon tetrachloride. Since the system began operation in 1996, more than 78,000 pounds of chemicals have been removed or destroyed.

There's a lot more to be done. DOE has estimated waste containing over 2,000,000 pounds of organic solvents and 600,000 curies of transuranic elements was buried at RWMC between 1952 and 1970.

DOE estimates the radioactivity will decrease by natural decay to roughly 300,000 curies by 2006.

The plume is but one of many cleanup challenges at the RWMC. Studies and planning efforts are underway to determine what else will be done to address environmental problems there.



The Subsurface Disposal Unit, usually called SDA, at the RWMC. This was taken in 1973.

Waste is buried in trenches and pits. As you see below, disposal practices have changed over the years.

In some areas, the waste is appropriately packaged and well-documented. In others, inappropriate packaging is corroding, and reliable records are hard to come by.

Disposal, probably of Rocky Flats waste, in 1973.

1975

1999

The building under construction at the top of the photo was to be used for an innovative cleanup at Pit 9. The project was designed to demonstrate how private contracts could be used to efficiently address contamination at DOE facilities.

Instead, the effort is mired in lawsuits, the building is abandoned, and the Pit has not been cleaned up. Probe holes were drilled in 2000 to help determine what the pit contains.

The top arrow points to Pit 17, and the second points to Pit 18, the "active" pit when this picture was taken in 1996.

Central Facilities Area

The Central Facilities Area primarily houses offices and laboratories. A contaminant plume from the CFA Sewage Treatment Plant Drainfield has been discovered under this facility. This plume covers part of the same area as the TRA/ INTEC plume, yet is separate, with distinct boundaries and one specific contaminant.

Where did it come from?

This small plume came from the Sewage Treatment Plant drainfield. Unlike the other INEEL plumes, this plume is not directly related to the INEEL's nuclear past. Contaminant plumes from drainfields occur in all areas where sewage is treated. Several communities in Idaho have similar plumes.

When did it happen?

Disposal occurred from 1952-1969.

What contaminants are in the water?

Nitrate, a common groundwater pollutant all over the state, not confined to the INEEL.

At what concentration is the contaminant?

The maximum levels of nitrate that have been detected in the two wells which are located in the plume are approximately 20 and 10 milligrams per liter. The most recent rounds of sampling show decreases in these levels. The maximum level allowed for drinking water is 10 milligrams per liter.

Is the plume expanding?

As only two wells are in the plume, and none are located in its projected path, scientists are unsure if the plume is expanding.

What's being done to clean it up?

The drainfield is scheduled to be capped in 2002, which should prevent precipitation from seeping through the drainfield.

Recent sampling and computer modeling indicate that contaminant levels in the plume may be decreasing. However, the plume will continue to be monitored to verify this.

Naval Reactors Facility

The Naval Reactors Facility was established in 1950. Three prototype nuclear reactors for powering Navy ships and submarines were built at NRF and were used to train U.S. Navy personnel in reactor operations. This training ended in 1995, although other operations continue at NRF.

Where did it come from?

Wastewater disposal methods, such as an industrial waste ditch, sewage lagoons, leaching pits and percolation ponds contributed to above-background levels of some metals and radionuclides in the groundwater. Chromium, used as a corrosion inhibiter in spray ponds, is the primary contaminant in the groundwater at NRF.

When did it happen?

Most of the contaminant releases occurred in the 1960s and early 1970s.

What contaminants are in the water?

Contaminants include chromium, nitrate, tritium and chloride.

At what concentration are the contaminants?

The average concentrations of contaminants exceed background levels, but no contaminants are present above levels allowed in drinking water.

Is the area of contamination expanding?

Because of the low concentrations of contaminants in the groundwater, scientists are unable to determine any clear trends in contaminant movements.

What's being done to clean it up?

Because contaminant levels are so low, remediation is not taking place. The site is carefully monitored.